

FOURTH PROGRESS REPORT
1979 OPERATIONAL REVIEW

ASSESSMENT OF SPAWNING HERRING AND CAPELIN STOCKS
AT SELECTED COASTAL AREAS IN THE EASTERN
BERING SEA

Prepared For The
North Pacific Fishery Management Council
Contract 78-5

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INTRODUCTION

This report describes the operational plans for the 1979 field season, the second season of research on Bering Sea herring stocks under North Pacific Fishery Management Council (NPFMC) contract 78-5. The results of the first year's investigations have been documented in the second and third progress reports. The central objectives of the research are to describe and monitor separate stocks of herring and to evaluate spawning. A secondary objective is to evaluate survey methods for validity, practicality and future application.

Accomplishment of those objectives in 1979 will depend upon carefully integrated field effort between NPFMC research and ADF&G General Fund research and management programs for the following reasons:

1. The area of concern includes nearshore waters covering about 1600 miles of western Alaska coastline, all of which is remote from roads and support facilities.
2. The herring spawning season in any given area of the Bering Sea is limited to approximately one month, thus most of the research and commercial fishing activities are compressed in time.
3. The commercial fishing and processing efforts directed toward Bering Sea herring in 1979 are expected to be at least triple the levels of 1978.
4. Funds and manpower available to conduct the needed research and to manage the fisheries are limited.

Therefore the plans included in this report address both NPFMC and ADF&G objectives and integrate personnel and funding from both sources. Funding sources for the various segments are identified. The plans

were written by a team of research and management biologists who have been involved in prior studies of Bering Sea herring and who will be responsible for the work in 1979.

OBJECTIVES

The central and secondary objectives of the NPFMC Bering Sea herring research contract were stated above. Specific objectives of that contract as amended in November 1978 are as follows:

1. Describe the spatial and temporal distribution and relative abundance of spawning herring at selected sites in the eastern Bering Sea.
2. Evaluate estimation methods of surface area and biomass of fish schools observed during aerial surveys.
3. Monitor age, sex, size and relative maturity of herring stocks by gear types at selected sites in the eastern Bering Sea.
4. Interpret stock strength and determine to what extent stock strength is affected by commercial harvests.
5. Monitor type and extent of spawning substrates and spawn deposition at selected sites in the eastern Bering Sea.
6. Evaluate the use of infrared photography in determining the extent and type of spawning substrates at primary tidal and subtidal spawning locations in the Togiak area of Bristol Bay.
7. Integrate these studies with National Marine Fisheries Service (NMFS) offshore herring studies and to supply supplemental data and specimens to NMFS to facilitate stock differentiation efforts.

In addition, ADF&G has a similar series of management and research objectives:

1. Determine the relative abundance of herring and herring spawn, distribution, timing and composition of the stocks.
2. Determine the magnitude and composition of the commercial and subsistence harvests.
3. Determine the magnitude of the commercial fishing efforts by gear type area and time.
4. Determine the magnitude of the processing effort.
5. Regulate the commercial harvests of herring sac roe and roe on kelp.
6. Inventory the kelp beds and other herring spawn substrate in the Togiak District.
7. Determine the efforts of the roe on kelp fishery on the herring and kelp resources of the Togiak District.

OPERATIONAL PLANS

To fulfill the preceding list of research and management objectives in 1979, detailed operational plans addressing five activities have been written:

1. Aerial surveys (Appendix A).
2. Shore-based studies (Appendix B).
3. Substrate studies and roe on kelp monitoring (Appendix C).
4. Management and logistics (Appendix D).
5. Commercial catch sampling (Appendix E).

Each of these plans addresses two or more of the NPFMC or ADF&G objectives (Table 1). Certain of these plans involve detailed sampling methodologies (e.g. scale sampling and reading) or sampling forms which have not been included in this report. These may be obtained from the

Table 1. Application of operational plans to NPFMC contract and ADF&G objectives.

<u>NPFMC Bering Sea Herring Contract Objective</u>	<u>Aerial Surveys</u>	<u>Shorebased Studies</u>	<u>Substrate Studies</u>	<u>Management Operations</u>	<u>Catch Sampling</u>
1. Describe the spatial and temporal distribution and relative abundance of spawning herring at selected sites.	X	X			
2. Evaluate estimation methods of surface area and biomass of fish schools observed during aerial surveys.	X				
3. Monitor age, sex, size and relative maturity of herring stocks by gear types at selected sites.		X			
4. Interpret stock strength and determine to what extent stock strength is affected by commercial harvests.	X	X			X
5. Monitor type and extent of spawning substrates and spawn deposition at selected sites.			X		
6. Evaluate the use of infrared photography in determining the extent and type of spawning substrates at primary tidal and subtidal spawning locations in the Togiak area.			X		
7. Supply supplemental data and specimens to NMFS to facilitate stock differentiation efforts.		X			
<u>ADF&G Management and Research Objectives</u>	<u>Aerial Survey</u>	<u>Shorebased Studies</u>	<u>Substrate Studies</u>	<u>Management Operations</u>	<u>Catch Sampling</u>
1. Determine relative abundance of herring and herring spawn, distribution, timing and composition of the stocks.	X	X	X		
2. Determine magnitude and composition of commercial and subsistence harvests.		X			
3. Determine magnitude of commercial fishing effort by gear type, area and time.	X		X	X	
4. Determine the magnitude of processing effort.				X	
5. Regulate the commercial harvests of herring sac roe and roe on kelp.			X	X	
6. Inventory kelp beds and other herring spawn substrate in Metervik Bay.			X		
7. Determine effects of the roe on kelp fishery on the herring and kelp resources of Metervik Bay.			X		

Anchorage office of ADF&G (Commercial Fisheries Division) upon request.

It is planned that NPFMC Bering Sea Herring contract funds will be applied exclusively to the following work segments:

Aerial Survey

Approximately 44 hours of flight time on light fixed wing aircraft so as to survey all major index spawning areas south of Port Clarence at least three times.

Shore-based Studies

Costs of two-man temporary sampling crews for five of seven study sites plus one temporary for about 10 days to assist in sampling at Port Clarence after the Cape Denbigh camp is disbanded. Also transportation costs to deliver and remove the crews and costs of food, sampling supplies and camp gear not already available.

Substrate Studies and Roe on Kelp Monitoring

Shore-based crews described above will map substrate and herring spawn at six of the seven study sites and assist with in-depth studies of herring spawn and kelp at Metervik Bay.

Also sub-contract of aerial infra-red and color photography in the Togiak District.

Catch Sampling

Limited sampling of commercial catches by shore-based crews at Goodnews Bay, Security Cove, Cape Romanzof and Cape Denbigh if necessary.

Other

Costs of one temporary for the Dillingham office to assist with logistical support of the shore-based crews.

Also salaries, benefits and associated costs of the Principal Investigator and a biologist assistant.

ADF&G will fund the following:

Aerial Survey

Additional aerial survey as needed, to manage the fisheries, particularly in the Togiak District. Also all surveys north of Port Clarence. All data to be collected in the same manner and pooled for analysis at the end of the season.

Shore-based Studies

Costs of the two-man temporary sampling crew at Cape Romanzof.

Substrate Studies and Roe on Kelp Monitoring

Costs of three temporary technicians and two permanent biologists at Metervik Bay to monitor the roe on kelp fishery and supervise substrate mapping and in-depth studies of herring spawn and kelp.

Also all food and sampling supplies and equipment for the spawn-kelp study in Metervik Bay and for the crew at Cape Romanzof.

Management

All management activities will be funded by ADF&G.

Catch Sampling

All catch sampling activities will be funded by ADF&G except as noted above for Goodnews Bay, Security Cove, Cape Romanzof and Cape Denbigh.

Other

Subsistence surveys in Nelson Island villages.

LOCATION OF STUDY AREAS

Research in 1979 will be conducted out of seven base camps located at Metervik Bay, Tongue Point, Goodnews Bay (Platinum), Nelson Island, Cape Romanzof, Cape Denbigh and Port Clarence (Fig. 1). Commercial catch sampling in the Togiak District will be conducted primarily from aboard two ADF&G vessels (Resolution and Stellar) which will be capable of moving between fishing grounds. Management of the fisheries will be

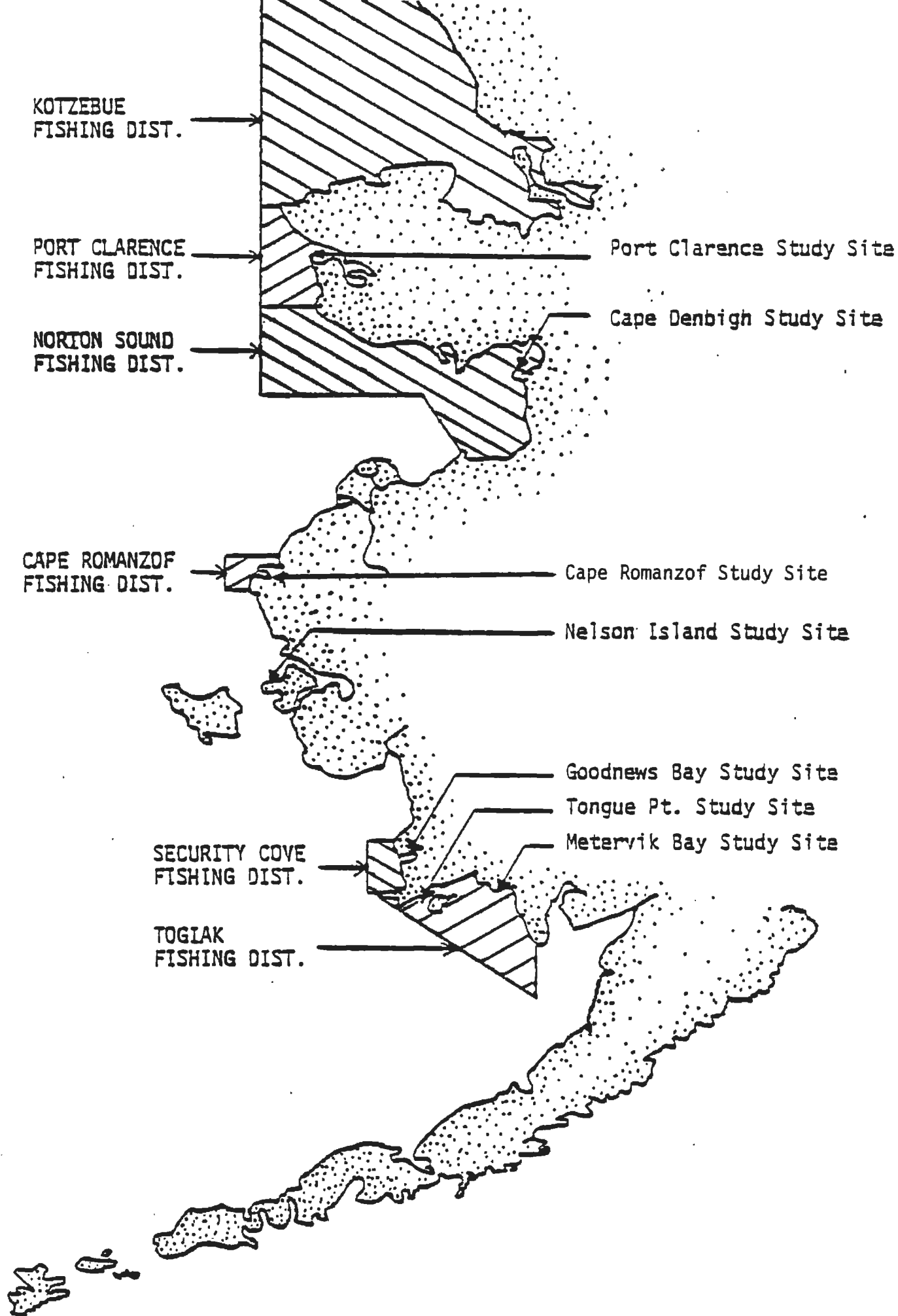
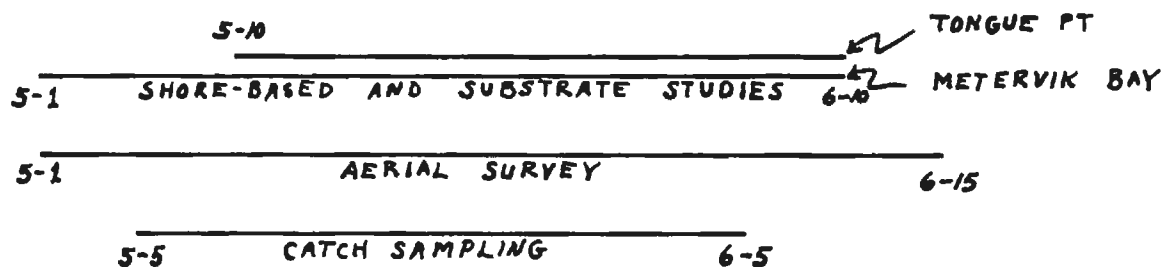


Figure 1. Locations of study sites and fishing districts.

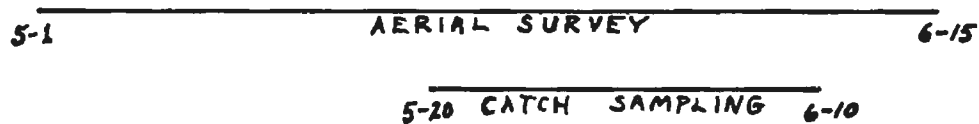
conducted out of ADF&G offices in Dillingham, Bethel and Nome.

SCHEDULE OF ACTIVITIES

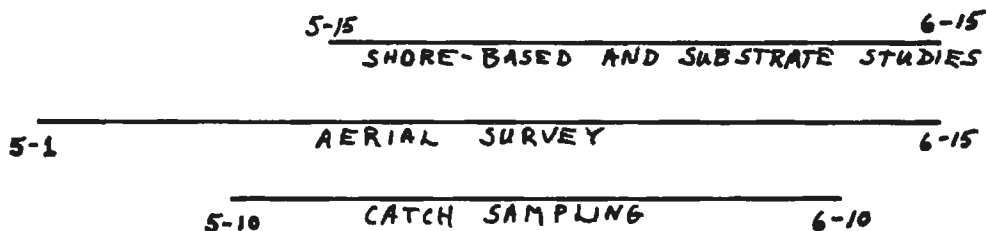
A projected time-table of the various activities in 1979 is shown in Figures 2 and 3, however, it should be kept in mind that these plans describe activities and events as anticipated two to four months prior to the herring spawning and commercial fishing seasons. Changes may occur prior to or during the field season due to unforeseen problems such as funding, vessels, weather, ice breakup or behavior of the herring.



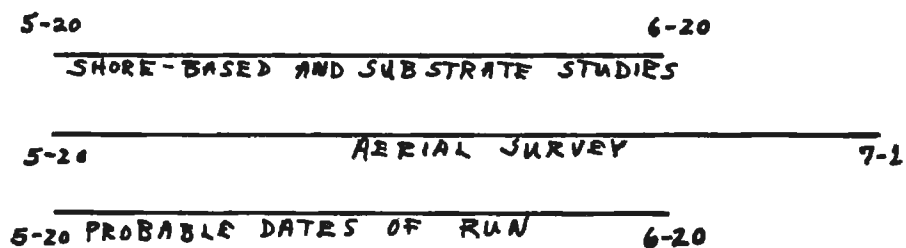
TOGIAK DISTRICT



SECURITY COVE DISTRICT



GOODNEWS BAY DISTRICT



NELSON ISLAND

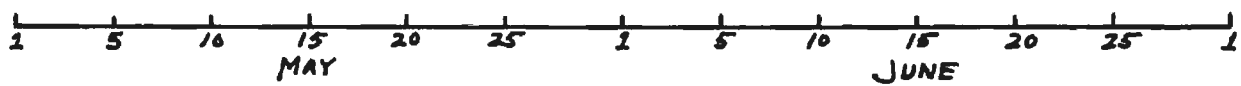


Figure 2. Tentative schedule of herring research and management activities in the Togiak, Security Cove, Goodnews Bay and Nelson Island areas, 1979.

APPENDIX A - AERIAL SURVEYS

I. OBJECTIVES

- A. Determine timing, distribution and relative abundance of spring herring populations along selected coastal areas (major spawning areas) for in-season management and prior year comparisons.
- B. Determine and assess commercial fishing fleet distribution and approximate effort levels for sac roe and roe-on-kelp fisheries.
- C. Examine estimation methods of herring biomass from surface area estimates of fish schools.
- D. Coordinate aerial sightings of herring/capelin schools, herring spawn, fleet location, etc. with on-going ground test fishing, catch sampling and substrate study projects to assist those programs and provide verification of fish identity and school size.

II. METHODS

A. Study area, Frequency and Timing of Surveys

All surveys will be flown of selected coastal areas where spawning herring concentrations are known to occur from Bristol Bay north to Bering Strait. Surveys will commence with spring breakup of the Bering Sea in respective areas or arrival of commercial herring fleets. They will be spaced so as to encompass timing of spawning runs. Surveys will be intensified in areas during peak herring spawning and commercial herring fishing activities. With regard to management, surveys will basically be flown as needed and no set schedule or frequency pre-established.

Aerial surveys in the Bristol Bay area will coincide (when conditions permit) with low slack tides, which will require

departing Dillingham approximately one hour before low water. Surveys of areas between Cape Newenham and the Yukon River will be flown from Bethel, while those north of the Yukon River Delta (Norton Sound) will be flown from Nome. Anticipated dates of coverage are:

Bristol Bay-Goodnews Bay area	May 1 - June 15
Nelson Island Area	May 20 - July 1
Cape Romanzof Area	May 20 - July 1
Southeastern Norton Sound	June 1 - July 1
Nome - Cape Denbigh	June 1 - July 1
Nome - Port Clarence	June 25 - July 30

At least three surveys of the first and last two areas indicated above will be funded by NPMFC contractual studies. All remaining surveys will be funded by ADFG. All charges made to Council funds will be coordinated with Louis Barton or his assistant.

B. Data Collection

1. All coastal areas (tracklines) have been divided into census areas to facilitate data collection and analysis. Certain census areas have been identified as index areas (discussed later).
2. A tape recorder is helpful in data recording, however all information should be subsequently entered on "Herring Aerial Survey Data Summary" forms. Data to be recorded for each survey in addition to fish school counts, should include cloud cover (%), wind, water clarity, overall survey rating index and fishing activity (fleet distribution and abundance). Roe-on-kelp operations will be located, but generally effort levels will not be determined due to

difficulty in determining activities from the air.

3. The location of each fish school (or aggregations where unusually large numbers of schools are encountered) will be recorded by size category on topographical maps or special "lap maps". All maps (or clear copies) will be attached to completed forms. The surface area of each fish school will be estimated visually and recorded by size category:

<u>Estimated Surface Area (Sq. ft.)</u>	<u>Record As:</u>
1-500 (10x10, 10x50, etc.)	small
501-2,750 (20x30, 24x100, etc.)	medium 1
2,751-5,000 (20x150, 50x100, etc.)	medium 2
5,000+	large

The surface area of each "large" school will be estimated and recorded when possible. Every attempt will be made to do this in index areas, however, surface area estimates of all large schools may not be possible under certain adverse circumstances.

4. It is understood that use of this classification system may not be possible when unusually large numbers of schools extending a considerable distance offshore are encountered. In these instances attempts will be made to take high altitude photographs to enable later classification. However, the best visual count possible will be made and recorded in the case that photographs do not develop, thus precluding loss of all data. Photographs will also be made of herring fishing fleets.
5. Aerial surveys will be conducted in a similar manner with

experienced pilots, using similar procedures and support gear: polaroid glasses, stop watches, census maps, 800 - 1,500 ft. survey altitude, etc. Handheld grids will be utilized to help estimate school dimensions, especially offshore when no reference points are available. Grids will be calibrated for use from four altitudes (1500', 1000', 500' and 300'). The handheld grid was found to be extremely valuable in Norton Sound in 1978.

6. School counts by size category should be made for all areas examined if possible. However a special effort should be made to obtain as accurately as possible counts by size category in all "index" areas. This especially includes estimating the surface area of each large school. It is counts from these "index" areas which are used to derive a relative abundance index (RAI) for annual comparisons. The importance of a good survey of index areas cannot be over emphasized. Index areas are listed below and those of greatest importance are indicated by asterisks:

<u>Index Area</u>	<u>Census Areas</u>
**Metervik Bay/Kulukak Bay	T-3
**East Nunavachak Bay	T-4
**West Nunavachak Bay	T-5A
* Tongue Point	T-9
**Security Cove	18a, 18b, 18c
**Goodnews Bay	20b
**Nelson Island	23a, 23b, 24
Cape Romanzof	28, 29a, 29b, 30a
Klikitarik	34a - 37d

Unalakleet	38a, 38b
**Cape Denbigh	38c, 39a
* Norton Bay	39d - 40c
Golovin Bay	41a
* Bluff	42b, 42c, 43a
* Cape Wooley	43b, 43c, 43d
* Grantley Harbor	44a - 44e

7. Location and magnitude of herring spawnings (milt) will be noted on "lap" maps. Instances of offshore spawnings will receive additional coverage in an attempt to locate and define subtidal spawning.

III. DATA RECORDING AND REPORTING

All data obtained from aerial surveillance apart from commercial fishing effort will be summarized and analyzed by Council and State funded research biologists positions. Results will be presented in the Council completion report, due January 31, 1980. All data collected concerning commercial fishing activities will be analyzed and reported by respective ADFG Area Management Biologists.

IV. COMMUNICATION

Radio contact on VHF (Channel 7A) and CB (Channel 7) will be possible at all times between survey aircraft and ground crews.

All biologists flying aerial surveys should check with local area biologists prior to surveys for the possibility of splitting charter costs with other field projects.

APPENDIX B - SHOREBASED STUDIES

I. OBJECTIVES

- A. Determine spatial and temporal distribution of herring populations.
- B. Determine age, sex, maturity and size composition of herring runs.
- C. Determine distribution and density of herring spawn by substrate type.
- D. Collect herring samples for stock separation studies.
- E. Assist in commercial or subsistence catch sampling.
- F. Assist in subsistence use surveys.

II. METHODS AND PERSONNEL

A. Study areas, time tables and personnel

1. Metervik Bay (May 1 - June 10)

Three temporaries will be hired on NPFMC monies and assigned to the Metervik Bay study area. These three persons will make up part of the Metervik Bay crew (three other temporaries hired by ADFG - Bristol Bay funds).

All duties of this crew will be supervised by John Clark (or representative) as the majority of activities will be associated with substrate studies. However, in addition to substrate studies the Metervik Bay crew will be responsible for the following duties designed to meet NPFMC objectives.

- a. Fish variable mesh gillnets to determine age, sex, size and maturity characteristics of herring runs and to monitor species catch composition.
- b. Preserve at least 200 herring samples for stock separation analysis.

- c. Fish variable mesh gillnets and hand purse seines as possible to examine gear selectivity.

2. Tongue Point (May 10 - June 10)

A two-man crew (NPFMC) will sample coastal waters in the Togiak District from Tongue Point to Estus Point. This field project will be deployed from Dillingham by either aircraft or possibly the State vessel used in establishing the Metervik Bay camp. Base camp will be set up about mid way between the mouth of Matogak River and Tongue Point. This crew will be equipped with a 10'x12' wall tent, SSB field radio and Zodiac raft. Specific duties of this crew will include the following:

- a. Fish variable mesh gillnets to determine age, sex, size and maturity characteristics of herring runs and to monitor species catch composition.
- b. Preserve at least 200 herring samples for stock separation analysis.
- c. Map intertidal substrate (organic and inorganic) types within study area.
- d. Determine spawn deposition throughout this study area.

3. Goodnews Bay (May 15 - June 10)

This project will be set up and coordinated from the Bethel ADF&G office. A two-man crew (NPMFC funded) will sample waters of Goodnews Bay (particularly inside the north and south spit areas) and coastal waters of the Security Cove area from Pinnacle Rock to Castle Rock. Sampling in these two areas should be at least weekly - weather permitting. This crew will be equipped with a

10' by 12' wall tent, Zodiac raft and SSB field radio. A 24 foot cabin skiff will also be available for use. A base camp will be set up inside the south spit of Goodnews Bay near the village of Platinum. Duties of this crew will include the following:

- a. Fish variable mesh gillnets to determine age, sex, size and maturity characteristics of herring runs to both the Goodnews Bay and Security Cove Districts.
- b. Monitor catch composition by species of test fishing catches.
- c. Preserve at least 200 herring samples for stock separation analysis. An additional 200 samples may be collected so as to have 200 samples from each area. The first 200 however, should be taken in Goodnews Bay.
- d. Map intertidal (Security Cove area) and shallow subtidal (Goodnews Bay) substrate types in the study areas.
- e. Determine spawn deposition in both the Goodnews Bay and Security Cove study areas.
- f. Assist in commercial catch sampling and reporting.
- g. Monitor incidental species catch composition in the commercial gillnet fishery.

It is anticipated that one permanent biologist and temporary assistant will also visit the Security Cove and Goodnews Bay Districts to monitor commercial fishing activities and catch sampling. These personnel will use the 24 foot skiff when present. On these occasions, the two NPFMC temporaries will confine their activities to

the Goodnews Bay area by using a Zodiac raft. No attempt will be made to depart Goodnews Bay while in the Zodiac raft. The NPFMC crew will also assist in commercial catch sampling at Platinum on an as needed basis. Specific instructions will be provided at the time the project is established due to present uncertainties about commercial operations in these fishing districts.

Logistical support for this crew will be supplied from Bethel. However, it is anticipated that outboard fuel and oil can be purchased by FPOs in Platinum. An account will be set up at the village store in Platinum where some food items can be purchased.

It is important for the NPFMC crew to realize that the commercial herring operations in the Security Cove and Goodnews Bay Districts will be with straight mesh gillnets ranging in size from 2-1/3" to 3" stretch mesh, consequently commercial catch samples will not give a true indication of the age composition of herring runs to these districts. Most commercially caught herring will be of the older age classes (about Age VI+) due to selectivity of the commercial gillnets. For this reason, the importance of test fishing with the variable mesh gillnets cannot be over emphasized. The objective will be to obtain test fish samples in both study areas at least once per week. In addition sampling of the commercial catch from each of the two Districts will be attempted at least once per week also. The NPFMC crew should understand however, that absolutely no chances should be

taken when attempting a trip in the 24 foot skiff to the Security Cove area. Once in the Security Cove area the crew can probably overnight for 2-3 days to conduct activities there. The only place to secure the 24 foot skiff and camp however will be at Chagvan Bay.

4. Nelson Island (May 20 - June 20)

A two-man crew (NPFMC funded) will sample coastal waters from north Kangirivar Bay to Chinit Point (north of Tanunak). Base camp will be set up at the village of Tanunak. Specific duties of this crew will include the following:

- a. Fish variable mesh gillnets to determine age, sex, size and maturity characteristics of herring runs and to monitor species catch composition.
- b. Preserve at least 200 herring samples for stock separation analysis.
- c. Map intertidal substrate types and determine spawn deposition throughout the study area.
- d. Additional duties may include monitoring subsistence herring catches. A local resident at Tanunak (Mike Albert) will be paid with ADF&G funds to interview heads of households in Tanunak, Toksook and Umkimuit for determining herring subsistence catches. Special forms will be used by Mr. Albert in his interviews and a fee of \$2.00 per household will be paid. The NPFMC crew will frequent Mr. Albert to insure surveys are being conducted and periodically collect and assemble completed forms. The crew will also issue payment to Mr. Albert with FPOs as required.

Set up and logistics of this field project will be coordinated from the Bethel ADF&G office. The camp will consist of two 3-man drawtight tents and a Zodiac raft. Communications with the Bethel office will be made by landline at Tanunak.

5. Cape Romanzof (May 20 - June 20)

A two-man crew (ADF&G funded) will sample coastal marine waters from Paimiut to Point Dyer. A base camp will be set up in North Kokechik Bay at the U.S.A.F. base. Logistics and set up of the crew will be coordinated from the Bethel ADF&G office. This crew will be equipped with drawtight tents and a Zodiac raft. Specific duties will include the following:

- a. Fish variable mesh gillnets to determine age, sex, size and maturity characteristics of herring runs and monitor species and composition.
- b. Preserve at least 200 herring samples for stock separation analysis.
- c. Map intertidal substrate types and determine spawn deposition throughout the study area.
- d. Additional duties may include commercial catch sampling and/or subsistence herring surveys at Scammon Bay.

Instructions for commercial catch sampling or subsistence surveys will be provided at a later date due to the uncertainty of such activities in the Cape Romanzof area at this time.

6. Cape Denbigh (May 25 - June 25)

A two-man crew (NPFMC funded) will sample coastal marine waters of Cape Denbigh from the Sineak River to Point Dexter. A permanent camp will be set up on the north side of Cape Denbigh near Point Dexter during the last week of May or as soon as ice conditions permit travel from Unalakleet. Specific duties of this crew will consist of the following:

- a. Fish variable mesh gillnets to determine age, sex, size and maturity characteristics of herring runs and monitor species.
- b. Preserve at least 200 herring samples for stock separation analysis.
- c. Map intertidal substrate types and determine spawn deposition throughout the study area.

It is anticipated that two important areas will occur requiring variable mesh gillnet sampling by this crew: the area near Point Dexter and an area on the south side of Cape Denbigh. Tentatively, these areas should plan to be sampled every 3-5 days, weather permitting. A permanent camp (10' x 12' tent) will be established on the north side of Cape Denbigh. It will be located where a 22 foot skiff can be safely anchored and protected from inclement weather. The skiff should be securely anchored offshore via pulley system, using not less than 22 pound danforth anchors. The skiff should not be beached for any length of time.

The crew will be provided with a PT-300 VHF portable radio. This unit will be used for ground to air communications

with aerial observers. The ground crew should always insure this unit (provided with charger) is fully charged and carry it (water proofed) in the 22 foot skiff. Channel #1 will be the frequency used. The aerial observer will direct the ground crew to areas where herring concentrations are observed. This will be done by use of the PT-300 radio and gridded maps. In the case that the radios do not function, then gridded maps showing the location of sighted schools will be dropped to the ground crew from the plane.

Supply and logistics for this crew will be coordinated from the ADF&G office in Nome.

7. Port Clarence (July 1 - July 10)

One temporary and permanent biologist will sample the outlet end of Grantley Harbor. Operations will be based from the village of Teller. The temporary will be one of the Cape Denbigh crew after termination of that project. Duties will include:

- a. Fish variable mesh gillnets to determine age, sex, size and maturity characteristics of herring runs.
- b. Preserve at least 200 herring samples for stock separation analysis.

Sampling will be conducted from a Zodiac raft. Transportation to and from Teller will be via road and housing will be at the old Department of Highways building in Teller.

B. Sampling design and techniques

1. Test Fishing Methods: (1) test fishing will be conducted daily except during severe storms; (2) if catches cannot be given to local fishermen, then fish should be disposed by burial in upland sites; however bear problems should be taken into consideration; (3) when herring are abundant, gillnets should be fished for only short periods of time under constant attendance to minimize wastage; (4) fishing times, fishing locations (Note on map) and total catch by species by mesh size are to be recorded; (5) crews should attempt to operate gear in areas where fish are located, "pre-established" fishing sites are not to be utilized; (6) onshore gillnet sets should be made with the smallest mesh panel fishing toward shore; (7) if large catches are encountered the fish can be placed in garbage bags, labeled and sampled upon return to camp.

a. All multifilament gillnets will be 150 ft long x 10 ft deep consisting of six 25 ft. panels with the following stretch mesh sizes: 1.0, 1.5, 2.0, 2.5, 3.0 and 4.0 inch. Depending on the abundance of fish, all gillnet sets will be one hour in duration. No more than two gillnets should be fished at any one time. Floating gillnets should be immediately retrieved when the cork line is observed bobbing or when large numbers of adult salmon are observed hitting the net. Gillnet sets should be checked frequently when adult salmon runs are occurring. Adult salmon can be expected in the coastal waters any time from late May through early July. Under no

circumstances should gillnets be set and left unattended or fished overnight. If foul weather becomes a problem, at least one end of the net should be released permitting the net to "flag" if at all possible. However, safety of the crew should always come first.

- b. Enumerate total catch of each species per each gillnet set and herring by gillnet mesh size. Record data on appropriate catch (attached) form along with date, duration of set, local of station (indicate on map) and depth fished.
- c. Catch samples will be placed in large garbage bags. Samples should be processed within 48 hours after return to camp. Insure bags are properly labeled (by panel mesh size, date, sampling location).

2. Sampling Design: A minimum of 800 herring shall be sampled for age, sex, standard length and maturity information at each study area. The first 400 herring captured will be sampled without subsampling in case no further herring are caught. Samples beyond the first 400 will be selected representatively from each gillnet panel and sampling the net catch is as follows:

- a. With catches of 400 to 600-subsample one in two; (2) 600 to 800-subsample one in three; (3) 800 to 1000-subsample one in four; (4) 1000 to 1500-subsample one in six; (5) 1500 to 2000-subsample one in ten; (6) greater than 2000-subsample one in fifteen.

Sampling information (1) scale sample, sex-maturity (from visual examination of gonads) and standard

length (tip of snout to hypural plate) should be taken from each fish sampled. Scales should be placed on microscope slides along with the date, gear and subarea of capture; (2) scales should be taken from the preferred body area; and (3) the relative maturity recorded (Table 1).

3. Stock Separation: Samples of whole herring will be preserved by freezing for later electrophoretic analysis. This should be coordinated with the aerial surveyor so freshly caught samples can be picked up with the float plane for freezing. A sample size of 200 herring is desired. To insure coverage of the primary spawning ages (4-9) a stratified sampling scheme will be employed whereby a number of fish are taken for each 10mm interval over the range of sizes captured at each site. The extreme size range for ages 4-9 appears to be 180-270mm. If this distribution was encountered at a site, then 20 fish would be taken from each 10mm interval beginning with 180mm. Samples will be packed in styrofoam shipping containers, frozen, and shipped airfreight, collect, to the National Marine Fisheries Service, Northwest and Alaska Fisheries Center, 2725 Montlake Blvd. East, Seattle, Washington 98112 (Attention: V. G. Westpestad) for processing.
4. Spawn Timing: At a selected site or sites determine within a day or two when the first spawning occurs. These sites should be monitored periodically (every 2-3

days) to determine the length of time required for egg incubation until hatching. Record when eggs become "eyed", turn opaque (dead) or hatch. Also determine if successive spawning occurs by noting the numbers of egg layers deposited. These sites should be carefully marked with buoys or florescent flagging.

5. Spawn Surveys: (1) All exposed beaches and shallow shoreline waters should be examined weekly at low tide for the presence of deposited herring spawn; (2) all spawning substrates utilized and preferred substrates utilized should be noted; (3) foot or boat surveys will be utilized in these surveys; (4) primary and secondary spawning deposition areas are to be located on maps.

Ground crews will use the following four subjective categories to estimate substrate density in both spawning and non-spawning areas in their study area:

- 1) very light - 0% to 19%
- 2) light - 11% to 35%
- 3) medium - 36% to 65%
- 4) heavy - 66% to 100%

Ground crews should essentially end up with a vegetative map of their study area showing the density of various substrate types (e.g. Fucus sp. or Zostera sp.) along the coastline. Herring and capelin spawning areas will be documented on these maps along with egg deposition and density.

6. Climatological Data: Record daily surface water temperatures adjacent to campsite and spawning areas. Also record weather conditions (i.e. cloud cover, wind direction and

velocity, etc.). Enter all data on special climatological forms or in field notebooks if specific forms are not provided. Water salinity may also be monitored if meters are available.

III. DATA RECORDING AND REPORTING

All field data will be recorded legibly and in a timely manner. Due to the size of the study area, limited personnel and relatively short spawning season, close coordination and good field communications (radio or telephone) between field crews and the principal investigator(s) should be maintained. All data collected should be transcribed neatly onto appropriate maps and/or forms as soon as possible after collection.

All field crews will be thoroughly briefed prior to the field season on their responsibilities and project sampling methodology. In addition, all persons should read the complete set of operational plans to familiarize himself with the program and sampling instructions.

All crew leaders will be required to keep a daily log of activities. Yellow, rite-n-rain notebooks will be appropriate. Information contained in log books should include, but not limited to stations sampled, gear types used, description of spawning habitat (escarpments, beach type, vegetation, etc.) comments by local residents (e.g., dates and locations of spawning by various species of fish), problems encountered, observations of marine mammals and bird, comments on the days activities. A special effort should be made to observe and record any areas where spawning substrates may be denuded from storms or wave action. All log books will be turned in to the Principal Investigator at the end of the sampling season. In addition, all crew leaders will be responsible for completing a report for their project at close of

season.

All crew leaders will be directly responsible for insuring all equipment is properly inventoried and cleaned at the close of the sampling season. A package of inventory forms to be completed will be provided. General camp and equipment maintenance (e.g., oiling tools and stoves and repair sampling nets, etc.) will be a daily activity.

The overall summary, analysis and reporting of data collected from each ground sampling area will be the responsibility of NPFMC principal investigator for contract 78-5.

IV. COMMUNICATIONS

Crews at Metervik Bay, Tongue Point, Goodnews Bay and Cape Denbigh will maintain daily radio contact with ADF&G field offices. The Tongue Point and Metervik Bay crews will operate on SSB, frequency 4560 and communicate with the Dillingham office. The Goodnews Bay crew will operate on SSB frequency 3230 and communicate with the Bethel office. The Cape Denbigh crew will contact the Nome office, also using SSB frequency 3230.

The Nelson Island, Cape Romanzof and Port Clarence operations will be monitored daily by landline from Tanunak, USAF station in Kokechik Bay and Teller. The first two will contact Bethel and the Pt. Clarence crew, Nome.

All herring sampling crews will be equipped with either handheld CB radios or portable VHF radios for communication with aerial survey biologists during the sampling season. Channel 7 will be used on all CB radios for ADF&G communication.

Table 1. Definition of Herring Maturity Codes.

<u>Maturity</u>	<u>Key Characteristics</u>
1	Virgin herring. Gonads very small, threadlike, 2-3mm broad. Ovaries wine red. Testes whitish or grey brown.
2	Virgin herring with small sexual organs. The height of ovaries and testes about 3-8mm. Eggs not visible to naked eye, but can be seen with magnifying glass. Ovaries a bright red color, testes a reddish grey color.
3	Gonads occupying about half of the ventral cavity. Breadth of sexual organs between 1 and 2 cm. Eggs small but can be distinguished with the naked eye. Ovaries orange; testes reddish gray or grayish.
4	Gonads almost as long as body cavity. Eggs larger varying in size, opaque. Ovaries orange or pale yellow; testes whitish.
5	Gonads fill body cavity. Eggs large, round; some transparent. Ovaries yellowish testes milkwhite. Eggs and sperm do not flow, but sperm can be extruded by pressure.
6	Ripe gonads; eggs transparent; testes white; eggs and sperm flow freely.
7	Spent herring gonads baggy and bloodshot. Ovaries empty or containing only a few residual eggs. Testes may contain remains of sperm.
8	Recovering spents. Ovaries and testes firm and larger than virgin herring in State II. Eggs not visible to naked eye. Walls of gonads striated; blood vessels prominent.

APPENDIX C. SUBSTRATE STUDIES AND ROE ON KELP HARVEST MONITORING

OBJECTIVES

The objectives of this portion of the 1979 Bering Sea Herring Operational Plans are to outline methods to allow the Department of Fish and Game to; 1) monitor the roe on kelp fishery; 2) provide an inventory of the kelp resource; and 3) collect biological data needed to determine the effect of this fishery on the herring and kelp resources of the Bering Sea. The objectives may be further expressed as follows:

I. Monitoring the Fishery:

- A. Monitor commercial roe on kelp harvest of the Togiak District in terms of time, condition of roe, area harvested, biomass harvested, and incidence of waste.
- B. Monitor the commercial roe on kelp harvest of the Norton Sound District by fish ticket analysis.

II. Resource Inventory:

- A. Map intertidal spawning substrates at selected study sites along the western Bering Sea coast by ground surveys.
- B. Determine the density of herring spawn on intertidal substrates during ground surveys (II. A.) and throughout the later segments of the spawning run at these selected study sites.
- C. Evaluate infrared aerial photography as a substrate mapping tool, and if applicable, use this tool to map spawning substrates in the Togiak District.
- D. Estimate biomass of intertidal kelp from Kulukak Point to Right Hand Point in the Togiak District.

- E. Map the distribution of subtidal kelp and determine density of herring spawn (at the time of mapping) in Metervik Bay, Togiak District.
- F. Document and determine the extent of subtidal spawning whenever possible.

III. Biological Studies:

- A. Establish three controlled study areas at Metervik Bay for long term study of spawning substrate resources and the effect of the commercial harvest on these resources.
- B. Determine percent survival of herring eggs on kelp at selected intervals of depth in the intertidal and shallow subtidal zones of Metervik Bay.
- C. Observe and document regeneration of kelp in areas of Metervik Bay commercially harvested in 1977 and 1978.
- D. Initiate a study at Metervik Bay to quantify the long term regeneration rate of kelp when subjected to various means and intensities of harvest.

METHODS

Areas of Interest

The herring spawning ground of the eastern Bering Sea have been divided into six fishing districts. However, roe on kelp harvest is permitted only in the Togiak and Norton Sound fishing districts. In addition seven study sites have been established by ADF&G between Bristol Bay and Norton Sound where studies of herring spawn and spawning substrate will occur (Fig. C-1).

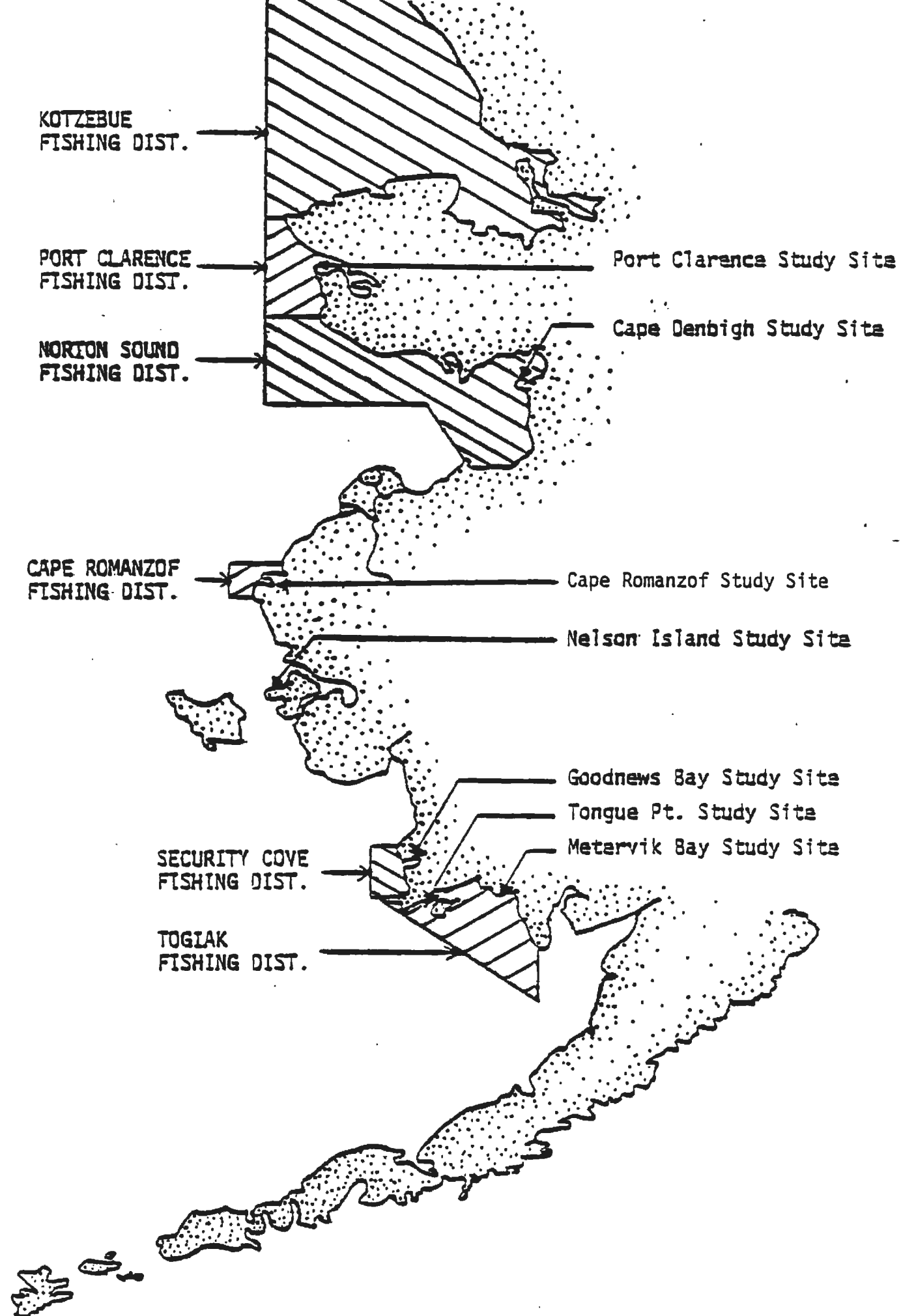


Figure C-1. Locations of study sites and fishing districts.

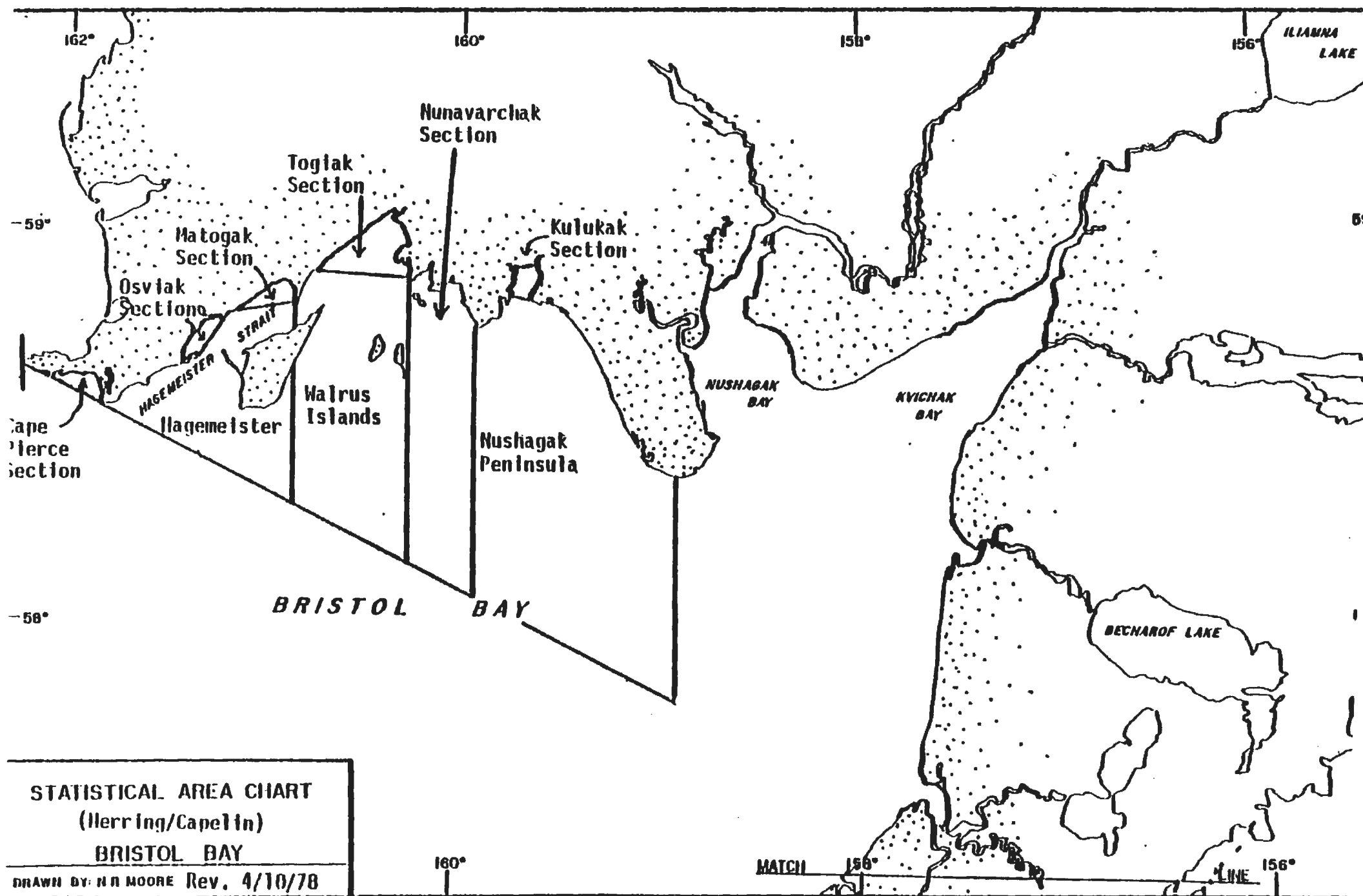
Togiak District

Most of the herring roe on kelp harvest in 1979 is expected to come from the Togiak District (Fig. C-2). The fishery in the Togiak District will be monitored by a fleet observer based at Metervik Bay. The primary responsibilities of the fleet observer will be to: 1) establish and maintain daily contact with all roe on kelp processors in order to collect harvest reports by statistical area; and 2) conduct daily surveys by boat of the roe on kelp fleet from Right Hand Point to Kulukak Point. If the majority of the roe on kelp fleet moves to the Nunavarchak section, the fleet observer will also conduct daily surveys of this section. Observations of the roe on kelp fleet elsewhere in the Togiak District will be made by periodic aerial surveys.

The fleet observer will make contact with each roe on kelp processor as soon as possible after the processor enters the Togiak District. Arrangements will be made to make daily contact either in person or by radio to report the previous day's purchase of roe on kelp. The following information will be reported daily for each statistical area:

1. Number of deliveries of commercial roe on kelp.
2. Total pounds of roe on kelp purchased.
3. General quality of roe on kelp purchased.
4. Number of fishermen which had roe on kelp to sell but which were turned down and the reasons why they were turned down.

The fleet observer will provide each processor with maps and forms to aid in reporting. A Harvest Report Summary form (Fig. C-3) will be completed each day by the fleet observer to summarize the total season's effort and harvest for each statistical area.



[illegible]

* D.R. = daily report

Figure C-3. Roe On kelp harvest survey form.

As soon as the roe on kelp harvest begins, the fleet observer will commence daily surveys of the roe on kelp fleet from Right Hand Point to Kulukak Point. The observer will map the location of any harvest activity in the survey area and record the following information:

- 1) Date
- 2) Time of day (Military format)
- 3) Tide stage (low, ebb, flood)
- 4) Number of fishermen
- 5) Types of kelp being harvested
- 6) Estimated area and percent cover of kelp bed before harvest
- 7) Estimated portion of kelp bed harvested
- 8) Layers of egg cover
- 9) Percent of eyed eggs and dead eggs
- 10) Presence of sand or other contaminants on eggs.

Any incidence of wastage will also be documented. A Roe on Kelp Fleet Survey form (Fig. C-4) will be used to record these observations.

Observations of the roe on kelp fleet elsewhere in the Togiak District will be made during the regular aerial surveys scheduled to record abundance of herring. The surveyer will record date, time, location, and estimated number of fisherman. These surveys as well as the daily processors summary will provide the in-season data necessary to manage the roe on kelp harvest of the Togiak District.

Norton Sound

Because only a small roe on kelp harvest is expected in the Norton Sound District no intense monitoring effort is planned for this area. Processors will report harvest to the area management biologist on at least a weekly basis. Additionally, crews at the Tongue Point, and Cape

(Kulukak)

Observer: _____

Date: _____

Time: _____

Approx. Tide Stage: _____

Weather Conditions: _____

Sea Conditions: _____

Indicate on the map the location and extent of each group of roe on kelp fishermen seen in the process of harvesting.

Mark the location by number and use the index below to provide additional information.

Use a different form each day.

Map Index

1. Number of Fishermen: _____ Type of Kelp(s): _____
 Area of Harvest: _____ % Ground Coverage of Kelp: _____
 Estimated Proportion of Kelp Present Harvested: _____
 Layers of Egg Coverage: _____ % of Kelp Covered with Eggs: _____
 % Eyed Eggs: _____ % Dead Eggs: _____
 Presence of sand or other contaminants on eggs: _____
 Comments: _____
2. Number of Fishermen: _____ Type of Kelp(s): _____
 Area of Harvest: _____ % Ground Coverage of Kelp: _____
 Estimated Proportion of Kelp Present Harvested: _____
 Layers of Egg Coverage: _____ % of Kelp Covered with Eggs: _____
 % Eyed Eggs: _____ % Dead Eggs: _____
 Presence of sand or other contaminants on eggs: _____
 Comments: _____
3. Number of Fishermen: _____ Type of Kelp(s): _____
 Area of Harvest: _____ % Ground Coverage of Kelp: _____
 Estimated Proportion of Kelp Present Harvested: _____
 Layers of Egg Coverage: _____ % of Kelp Covered with Eggs: _____
 % Eyed Eggs: _____ % Dead Eggs: _____
 Presence of sand or other contaminants on eggs: _____
 Comments: _____
4. Number of Fishermen: _____ Type of Kelp(s): _____
 Area of Harvest: _____ % Ground Coverage of Kelp: _____
 Estimated Proportion of Kelp Present Harvested: _____
 Layers of Egg Coverage: _____ % of Kelp Covered with Eggs: _____
 % Eyed Eggs: _____ % Dead Eggs: _____
 Presence of sand or other contaminants on eggs: _____
 Comments: _____

Summary: Total Number of Fishermen Observed on This Date: _____

Denbigh study sites will report any roe on kelp harvest activity to the area biologist. If the management biologist feels that the fishery has developed to the extent that further monitoring is necessary, he may want to contact members of the herring research team for assistance.

Intertidal Surveys

Ground surveys will be conducted in the intertidal zone at each of the seven Eastern Bering Sea study sites in 1979 to map the abundance and distribution of spawning substrates and to determine the density of spawn deposited on these substrates.

Substrate Mapping

The coast of each study area will be mapped as early in the season as possible. Surveys will be conducted either by foot or by boat at low tide. Substrate maps previously compiled for some of the study areas will be used as a reference. Maps and Substrate Survey forms will be used to note the location, type of kelp, dimensions, and percent cover of all intertidal kelp beds. The beach type and other prominent features throughout the study area will also be recorded. A key will be provided to each crew for kelp identification.

Spawn Density

Concurrent with the substrate mapping survey, spawn density surveys will begin at each study site. The methods to be used in these surveys are outlined in the British Columbia Herring Spawn Deposition Survey Manual (Humphreys and Hourston, 1978). This method calculates spawn density by estimation of the proportion of substrate covered and the number of layers of eggs on the portion covered. In comparison to the more subjective methods used in the past, the Canadian layer method allows for increased accuracies in calculating total spawn deposition.

This new method along with more accurate substrate maps should allow calculation of spawning escapement to the intertidal region of each study site. Upon completion of the initial survey, surveys will be repeated weekly to monitor spawn deposition as the run progresses. Maps, forms and a copy of the Canadian survey manual will be provided to each crew.

Aerial Infrared Mapping

Aerial infrared photography has been used in Canada for mapping of intertidal and shallow subtidal kelp beds (Haeghele, 1975; 1977; and Humphreys and Haeghele, 1977). However, it is unknown if these methods will be successful in the eastern Bering Sea.

An aerial photographer will be contracted to photograph the coast between Kulukak Point and Togiak Village with large format film (both infrared and color simultaneously). The photographs will be taken at an altitude such that the scale on the negatives is 500 feet to the inch. The photographer will provide ADF&G with infrared and color transparencies.

The section of coastline photographed will include Metervik Bay and will be coordinated with the research and mapping of intertidal and subtidal herring spawning habitat. In this manner the photographic data will be verified on the ground so that maps can potentially be drawn for entire photographed section of coast.

Intertidal Biomass Estimation

The objective of this portion of the substrate operational plan is to outline methods that will provide intertidal substrate distribution, density, and biomass estimates for the kelp beds on beaches most likely to receive heavy commercial harvest. These estimates will assist managers in determining the impact of commercial harvesting on the herring spawn

and kelp resources. Additionally, since substrate maps will be made in the same area (using both the ground survey and aerial infrared methods described earlier) the biomass estimation will allow quantitative evaluations and comparisons to these other methods. Biomass estimates will be calculated for the intertidal zones of the beaches from Right Hand Point to Kulukak Point with the exception of Metervik Bay which was estimated in 1978. The same technique will also be used at each controlled area as an evaluation tool.

The substrate distribution, density, and biomass estimates will be accomplished using methods outlined below and illustrated in Figure C-5.

- 1) Baselines A base line running roughly parallel to the high tide line will be established and measured.
- 2) Kelp Zones Kelp zones (any area of intertidal beach that is judged to contain more than one percent plant cover) will be located and staked at the baseline such that a line passed through the stake perpendicular to the base will denote one edge of the zone. The length of each kelp zone, (measured along the baseline) will be recorded.
- 3) Transects Random transects will be established in each kelp zone perpendicular to the baseline. Kelp zones less than 250 meters in length will contain five transects. Ten transects will be established in any kelp zone greater than 250 meters. Transect locations will be determined for each zone by selecting a random number, less than the length of the zone, from a random number table for each transect. Transects will then be located and staked along the baseline by measuring from the western edge of that zone. The length of each transect will

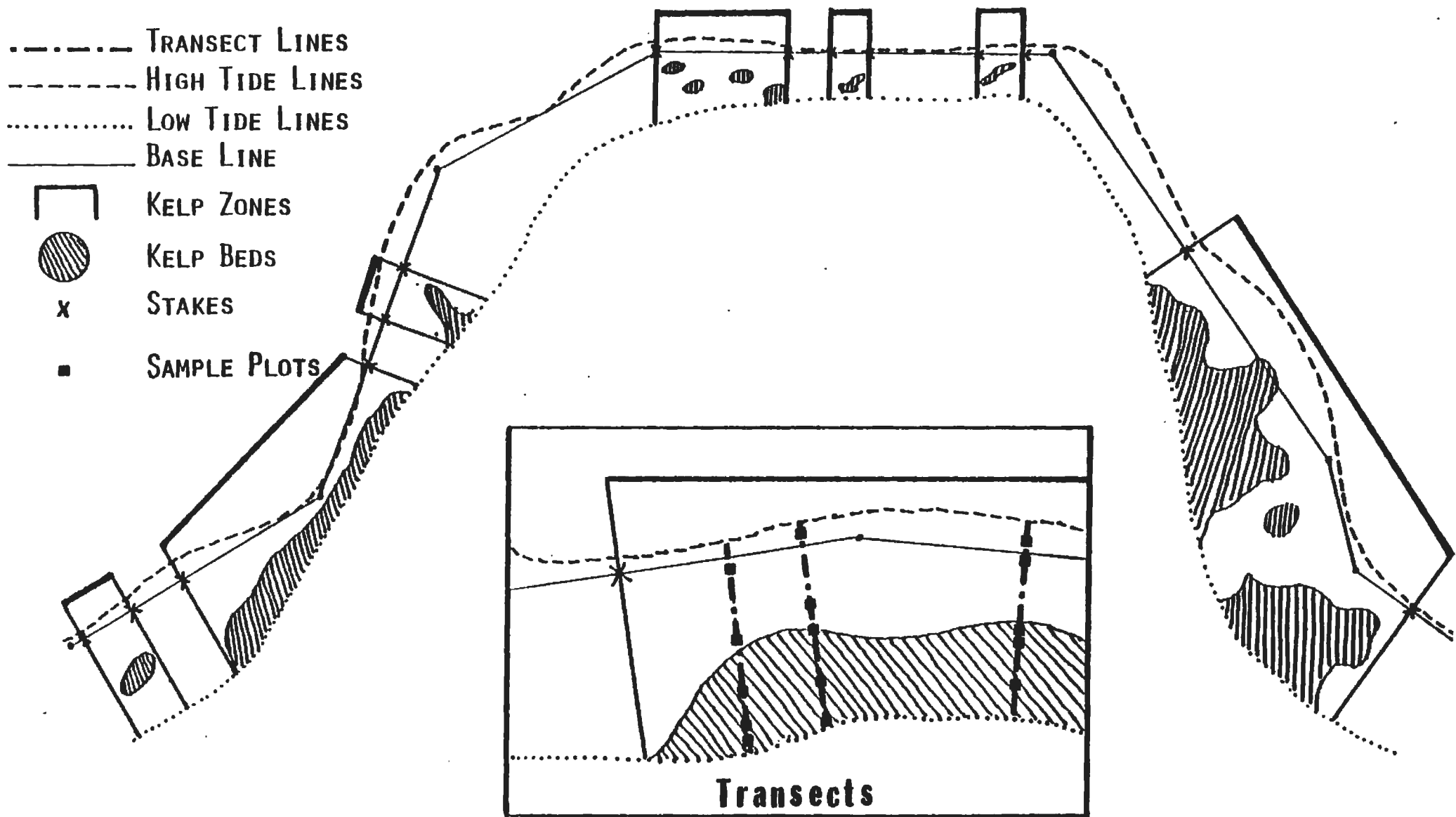


Figure C-5. Example of methods used to estimate biomass of kelp in intertidal zone.

be measured as the distance from the high tide line to the edge of the water at mean low tide.

- 4) Beach Profiles A beach profile will be constructed for each transect by drawing beach contours on a graph of tidal height (y-axis) and beach length (x-axis).
- 5) Sample Plots Ten random sample plots per hundred meters of beach width will be located along each transect by measuring from the high tide line. A random table of distances to plot centers will be provided to aid the crew in plot location along a transect. Each plot will be a 0.5 meter² section of substrate denoted by a portable frame.
- 6) Sampling Procedures Within each plot organic and inorganic ground cover will be visually estimated and soil type noted. All plants rooted in the plot will be removed, separated by species, washed, any herring eggs removed, and weighed to the nearest 0.1 gram.

Detailed instructions, forms, maps, and a kelp key will be provided to aid in carrying out these estimates.

Subtidal Surveys

Very little is known of the extent of subtidal spawning that occurs in the Bering Sea. Nothing is known of the subtidal distribution of kelp in the area. The magnitude of subtidal spawning must be estimated in order to determine the importance of the intertidal spawn deposition. The purpose of this portion of the 1979 operational plan is to outline ~~methods such that~~ subtidal spawning can be documented as often as possible and that the distribution and density of shallow subtidal kelp in Metervik Bay can be estimated.

Documentation of Subtidal Spawn

Suspected occurrences of subtidal spawning will be noted by ADF&G personnel in the Togiak District throughout the spawning run. Whenever possible, SCUBA dives will be made in the area immediately after the sighting occurs. Divers will sample several 0.5 meters² plots throughout the area. Percent ground cover and soil type will be noted for each plot. All vegetation rooted inside the plot will be removed, placed in plastic bags, and brought to the surface. If herring spawn is present spawn density will be determined via the Canadian layer method outlined in the Intertidal Surveys portion of this plan. Each vegetation sample will be sorted by species and weighed to the nearest 0.1 gram.

Subtidal Substrate Mapping

The following is an outline of the methods that will be used to map the distribution and density of aquatic plants in the shallow subtidal zone of Metervik Bay. Systematic sampling was chosen to provide the maximum coverage with the least possible effort.

- 1) Transect Lines Six transect lines will be established between prominent points in Metervik Bay (Figure C-6).
- 2) Plots Plots will be marked by anchored buoys dropped overboard while following a transect line in a skiff. Buoys will be dropped overboard at regular time intervals while traveling at a set speed, such that buoys will be spaced approximately 300 meters apart. A SCUBA diver will dive at each buoy and establish a .5 meter² plot at the anchor.
- 3) Sampling Procedures Within each plot organic cover will be visually estimated and soil type noted. All plants rooted in the plot will be removed, placed in a bag, and brought to the surface. Herring spawn density (if present) will be estimated

METERVIK BAY

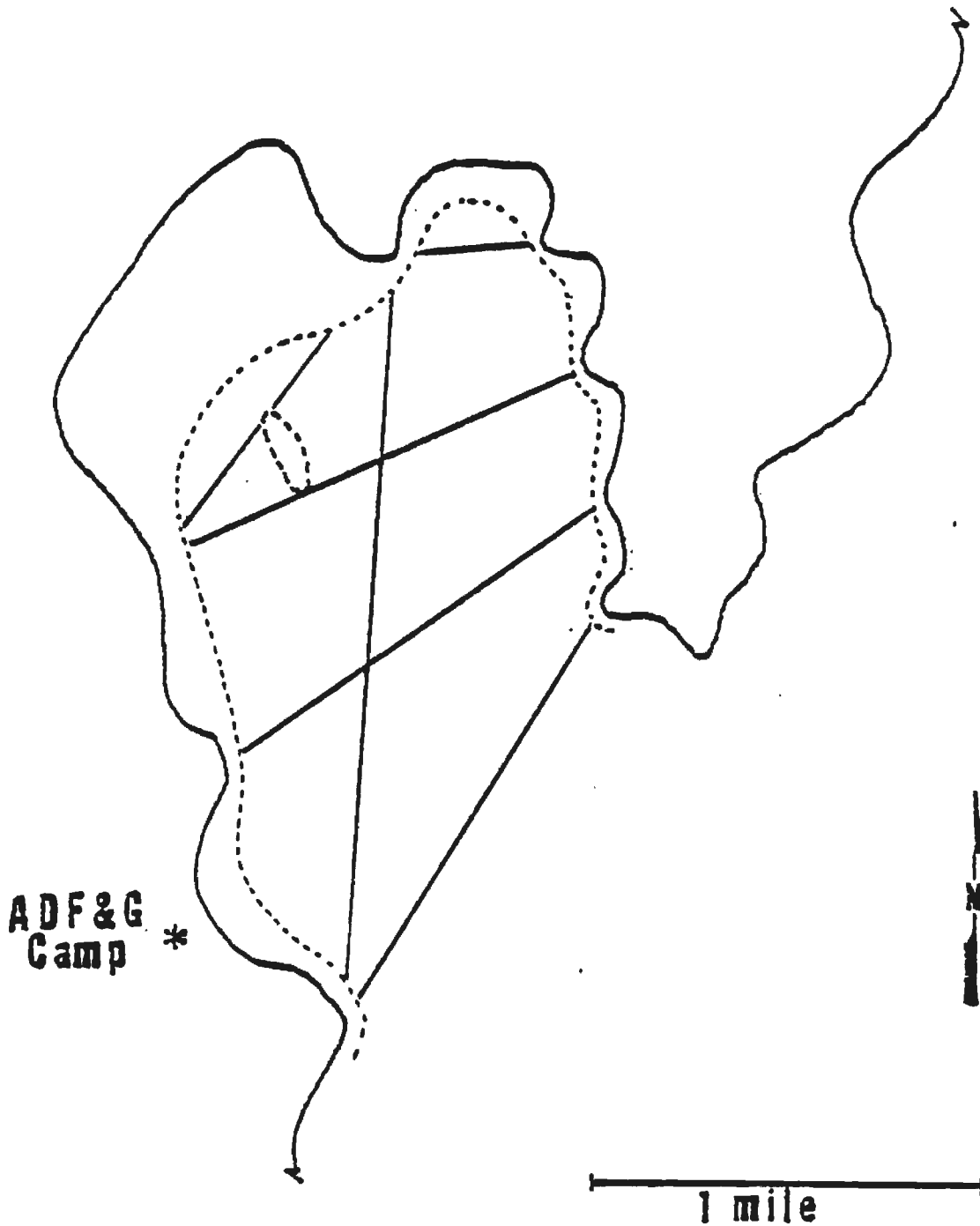


Figure C-6. Transect lines to be used for Metervik Bay subtidal kelp survey.
Dashed line is approximately mean low water.

using the Canadian layer method. Plants will be separated by species, washed, any herring eggs removed, and weighed to the nearest 0.1 gram.

Detailed instructions, forms, and maps will be provided to the crew to aid in these surveys.

Biological Studies at Controlled Areas

Controlled areas established at the Metervik Bay study site will allow long term biological studies of the intertidal plant community and the effect of the roe on kelp fishery on this community. Controlled areas will remain closed to all kelp harvest unless opened by emergency order. Success in maintaining the controlled areas will depend on clearly marking the perimeters of each area and informing each roe on kelp fisherman that the area is closed to roe on kelp harvest. A preseason public relations effort will be conducted to insure that the fleet is aware of these closed areas.

Three controlled areas are to be established (Figure C-7). The actual boundaries of these areas will be determined in-season and marked with semi-permanent markers on the beach. Intertidal biomass estimates, as described earlier will be conducted across each control area soon after the boundaries are determined. These biomass estimates will provide the baseline data necessary to evaluate the biological studies.

Control Area A This controlled area will be located along a one mile section of beach on the southeastern shore of Metervik Bay, in front of the ADF&G camp. The area contains several large beds of Fucus sp. and a small amount of eelgrass. These kelp beds were not harvested substantially in 1978. Two studies are planned for this area in 1979.

METERVIK BAY

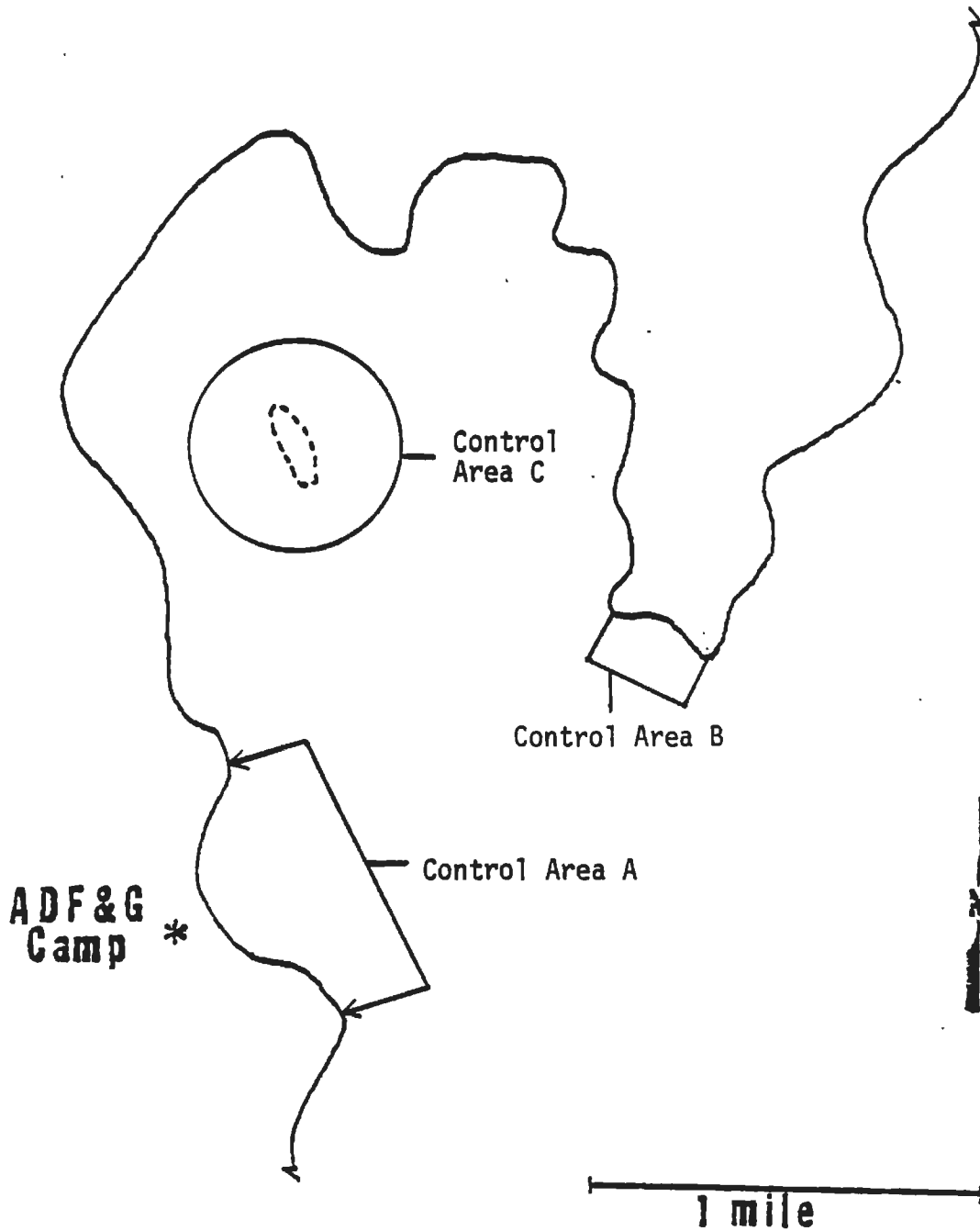


Figure C-7 Approximate locations of controlled areas at the Metervik Bay study site.

Survival-Depth Study The objective of this study is to determine the survival of herring eggs on Fucus sp. at various tidal depths across the intertidal and shallow subtidal zones. If egg survival is lower in the upper intertidal zone, relative to the lower intertidal and shallow subtidal zones, less damage would be done to the herring escapement by regulating future roe on kelp harvests to the upper zone of the intertidal zone.

This study will begin after the peak of the spawning run. A kelp bed that contains a moderate amount of spawn (one to five layers) and extends across the entire width of the beach, will be chosen as the study location. A transect line will be established across the width of the beach from the high tide line to the minus four foot contour. Mean low tide (mlt) will be located using the tide tables and a correction factor calculated for Metervik Bay. Explanation of this correction factor will follow. Using the mlt as a reference point, the transect will be divided into five sections. Each section will represent four feet of tidal depth (i.e. 16 to 12, 12 to 8, 8 to 4, 4 to 0, and 0 to 4). Five four meter² plots will be randomly selected in each section and staked. Spawn density will be determined for each plot using the Canadian egg layer method described earlier. Each plot will be further divided into eight 0.5 meter² subplots.

Sampling will begin as soon as herring eggs in any plot begin to eye. A single subplot within every plot will be sampled each day for eight consecutive days. A 0.5 meter² frame will be used to define a subplot. Percent eyed eggs

and percent dead eggs will be visually estimated. All plants rooted within the frame will be removed and preserved for future processing. Detailed instructions and data forms (Form 9) will be provided to the crew responsible for this study. If additional spawning occurs after the study begins the study must be repeated from the beginning.

The preserved roe on kelp samples will be processed either in the field or at the ADF&G Anchorage laboratory to determine the actual percent dead eggs. The methods necessary for this process are described in detail in Appendix VII. Detailed instructions will be provided to the personnel responsible for this work.

Fucus Regeneration Study The objective of this study is to determine the regeneration rate of Fucus sp. when removed from the intertidal zone at various rates and by several means. The study will begin early in June, after the herring run. Two subsections within control area A will be used for this study. The subsections will be selected in an area covered by at least 50% Fucus sp. Each subsection will be further divided into five treatment strips. The treatment strips within each subsection will be 2, 4, 8, 16, and 32 meters wide and extend from the high tide line to mlt. Treatment strips will be separated by a 20 meter wide buffer strip of undisturbed beach. Because it will be necessary to precisely locate each treatment strip again in future years, corners will be staked and the locations of the stakes will be determined by measuring bearings to nearby landmarks. Independent biomass estimates of the plant communities in each treatment strip will be accomplished using the methods described earlier.

All Fucus sp. will be removed from the treatment strips of one of the subsections by hand picking. However, all other aquatic plants will be left undisturbed. This subsection will be noted A-1. Subsequent yearly estimates of biomass in this subsection will provide estimates of the regeneration of Fucus sp. when in competition with other existing aquatic plants.

All aquatic plants, including Fucus sp., will be removed from the treatment strips of the other subsection, noted A-2. This removal will be accomplished by burning the treatment strips. Subsequent yearly estimates of biomass in this subsection will provide estimates of the regeneration rate of Fucus sp. and other aquatic plants, from bare soil. The data will also be analyzed to determine the effect of treatment strip width on the regeneration rates of Fucus sp. alone and Fucus sp. with other aquatic plants.

Other Procedures In order to determine tidal height at any given time, it is necessary to calculate a set of correction factors for the predicted tide tables. This will be accomplished by noting the exact time of each low tide for eight successive low tides. A correction factor will be calculated by averaging the difference between "book time" and "observed time" for both the low low tide and the high low tide.

Control Area B This controlled area will be located along a one mile section of beach on the southeastern shore of Kulukak Bay. The area contains large beds of Fucus sp. which were harvested in 1978.

It is uncertain if this area was harvested in 1977.

Effect of Harvest Study The control area will be divided into two equal subsections. As noted earlier, independent biomass estimates will be made on each subsection before any treatment. One subsection (B-1) will be opened to a one time harvest by the commercial roe on kelp fleet if and when herring spawn there. The other section (B-2) will remain closed. After the harvest has taken place another biomass estimate will be calculated for each of the subsections. The kelp biomass harvested can then be estimated. Subsequent biomass estimations in future years will provide estimates of the regeneration rates of harvested kelp beds for one and two year periods.

Control Area C This controlled area will include an intertidal island in the northern portion of Metervik Bay. The area contains both Fucus sp. and Laminaria sp. A biomass estimate was calculated for this area in 1978. The area was not harvested during 1978, however, most of the Fucus sp. on this island was harvested in 1977. A biomass estimate of this area will provide a rough estimate of Fucus sp. regeneration over one and two year periods. No other studies are planned for the area during 1979. However, the area will remain closed to allow further studies in the future.

PERSONNEL

Personnel at each of the seven study sites will be responsible for a portion of the substrate studies. Two-man crews at Tongue Point, Goodnews Bay, Nelson Island, Cape Denbigh, and Port Clarence will be funded by the North Pacific Fisheries Council (NPFC) contract and supervised by the Bering Sea herring research project leader. A similar crew at

Cape Romanzof will be funded and supervised by the A-Y-K Region Management. These crews will conduct intertidal surveys of kelp beds and spawn density at each site along with other NPFC related duties. The personnel stationed at Metervik Bay will include: 1) two permanent biologist, one to be SCUBA certified, 2) four temporary fisheries technicians, two each to be funded by the NPFC contract and two to be funded by ADF&G Commercial Fisheries (CF) general fund, and 3) a contracted SCUBA diver to be funded via CF general fund. Metervik Bay personnel will be supervised by the Westside Bristol Bay Research Project Leader. Table 1 provides a summary of the duties of all personnel related to the substrate studies.

Table . Summary of personnel and duties related to su¹ rate studies.

LOCATION	Position Description	FUNDING				DUTIES							
		NPFC Contract	CF General Fund	Intertidal Surveys	Other NPFC Duties	Fleet Observer	Intertidal Biomass Est.	Subtidal Surveys	Survival - Depth Study	Kelp Regeneration Study	Tidal Correction Factor	Effect of Harvest Study	Observation Of Any Misc. Roe On Kelp Harvest
METERVIK BAY													
	Crewleader (temp)	X	X			X			X			X	
	Asst. Crewleader (temp) X			X				X					
	Crewmember (temp)	X	X			X	X		X			X	
	Crewmember (temp) X			X		X		X	X				
	Contracted Diver	X					X	X		X			
	Permanent Biologist (SCUBA certified)	X	X				X	X	X				
	Permanent Biologist	X	X		X	X			X			X	
TONGUE POINT													
	Two-man crew (temp) X		X	X									X
GOODNEWS BAY													
	Two-man crew (temp) X		X	X									
NELSON ISLAND													
	Two-man crew (temp) X		X	X									
	CAPE ROMANZOF (2 man)	X	X										
CAPE DENBIGH													
	Two-man crew (temp) X		X	X								X	
PORT CLARENCE													
	Two-man crew (temp) X		X	X									

DATA REPORTS

A written report analyzing the 1979 roe on kelp harvest will be prepared by the fleet observer by September 1, 1979. Crew leaders at each study site will prepare reports summarizing all activities for which they were responsible. The Bering Sea Herring Research Project Leader will prepare a report summarizing the results of the infrared mapping portion of the substrate studies. He will also summarize all substrate related work conducted at Tongue Point, Goodnews Bay, Nelson Island, Cape Denbigh, and Port Clarence studies areas. These reports will be submitted by November 1, 1979. An additional report analyzing all spawning substrate studies will be prepared by the Bristol Bay research staff by December 1, 1979.

COMMUNICATION

Field camps will be in contact with the Dillingham, Bethel, and Nome area office daily by single side band radio. A daily summary of the roe on kelp harvest and effort will be reported to the Dillingham area office by the roe on kelp fleet observer. Hand held CB radios will be used for communication between field crews and field camps.

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APPENDIX D - MANAGEMENT AND LOGISTICS

I. OBJECTIVES

- (1) Monitor commercial harvest of herring sac roe fishery on a daily basis.
- (2) Determine range and average percent herring roe recovery.
- (3) Record relative abundance of herring through aerial survey means, and document miles of spawn by census area.
- (4) Regulate fishery by Emergency Order closure by time and area if needs dictate.

II. METHODS

A. Support Facilities, Gear and Equipment

1. Base Headquarters and Field Crews

- a. Base HQ's (Dillingham) to provide logistic support and communications center for all field crews in the Togiak District. Support for Goodnews Bay operations on a "as needed basis".
- b. Base HQ's (Dillingham) temporary crew will consist of: one maintenance man (funded by C.F. Mgt.) beginning approximately May 7; one supply person for pre-season support and in-season supply (funded by "NPFMC Herring") from approximately April 16 through June 8; and one Fishery Technician to handle in-season fish ticket catch compilation and editing and other data summary requirements (funded by C.F. Mgt.), beginning approximately May 21.
- c. Base HQ's (Bethel) to provide logistic support and communications for Goodnews Bay field crew. One commercial fishery catch sampler (temporary-funded by C.F. Mgt.) will assist Goodnews Bay crew and one

permanent staff biologist in field sampling and monitoring of commercial herring fishery in Security Cove and Goodnews Bay.

- d. Base HQ's (Nome) to provide logistic support and communications for Norton Sound commercial catch sampler/reporter. One temporary (funded by C.F. Mgt.) will be operated from Unalakleet and relocate as necessary to St. Michael, Moses Point, Elim and/or Golovin for monitoring commercial herring fisheries which may develop in Norton Sound. One permanent staff biologist to assist.
- e. Field HQ's (Bristol Bay) to consist of 3 crews:
 - 1) Support vessel #1 (M/V Steller) with a two man fishery monitoring crew (1 permanent biologist and 1 fishery technician). Permanent biologist to handle and coordinate in-season registration, catch reporting and all other monitoring efforts including special test fishing requirements, and provide transportation for fishery technician who will collect required AWL samples.
 - 2) Support vessel #2 (M/V Pandalus) with a two man fishery monitoring crew (1 permanent biologist and 1 fishery technician) with same responsibilities as (a) above.
 - 3) Metervik Bay field camp, crew of seven; 2 permanent biologists and 5 fishery technicians to monitor roe-on-kelp fishery and conduct various substrate study projects.

2. Information Packet

- a. A packet containing information on processor on-site registration, fishing regulations, sample fish tickets, catch reporting requirements and logs and various area maps will be mailed to all prospective processors interviewed by pre-season telephone survey.

3. On-Site Processor Registration

- a. On-site registration will be defined as registration with one of three ADF&G field operations in the Togiak herring fishing district: Vessel #1, Vessel #2 and the Metervik Bay field camp. On-site registration will be summarized on Form No. BB-CF/ 219. All roe-on-kelp only operations in the Togiak District will be referred to the Metervik station for registration.
- c. All sac roe registrations in the Togiak District will be referred to Vessels #1 or #2, if they are available. All "major" sac roe operators in this district will be required to register with the Department personnel on Vessel #1 or Vessel #2.
- d. No plans are available yet for other herring fishing districts.

4. Aerial Surveillance

- a. Coordinate aerial sightings of herring/capelin schools, herring spawn, and fleet location with Department test fishing and catch sampling crews.
- b. Coordinate when possible aerial sightings of fish

- schools with ground crews for verification of fish species and school size.
- c. Document fishing fleet location and approximate effort levels for both sac roe and roe-on-kelp fleets.
- d. Assess relative herring abundance and onshore movement (timing).
- e. Document herring spawn deposition and distribution on aerial "lap" maps.

5. Commercial Harvest

- a. Each company/processor of sac roe or roe-on-kelp will be required to conduct a daily pre-determined radio schedule with one of the Department field stations.
- b. Sac roe processors in the Togiak District missing two consecutive radio schedules or those who continuously miss schedules for any reason, will be given one warning. Second offenders will be cited.

This S.O.P. procedure will be given to all processors at the time of registration.
- c. Herring catch will be reported daily in person or by radio by each processor for its fleet.
- d. Additional information to be transmitted on a daily basis to field surveillance crews in the Togiak District will be:
 - (1) Range of roe recovery in percent (to nearest full percent), or average percent roe recovery;
 - (2) Area of catch will be noted under the comments column.

- e. In-season daily catch reports will not require catch breakdown by gear type, nor will we require in-season daily effort. Pre-season and in-season registration, as well as Limited Entry licensing summaries will suffice for the "general" level of fishing effort.
- f. Collection of daily harvest information in the Togiak District from the sac roe fishery will be divided equitably between the monitoring crew aboard the two major support vessels. One permanent biologist will assemble a daily concise fishery summary from the two data collection points and transmit it to the Dillingham HQ's office once per day on the regular radio schedule. Information and order of transmittal will be:
 - (1) Daily catch to nearest short ton;
 - (2) Accumulative catch to nearest short ton;
 - (3) Area of catch;
 - (4) Average roe recovery to nearest full percentage point;
 - (5) Other pertinent miscellaneous information.

6. Regulation of Harvest

- a. The relative abundance of herring as determined by aerial means, miles of actual spawn, roe recovery rate and year class proportion and strength will dictate if the actual harvest will be allowed to exceed guideline harvest levels or cut short of intended guideline levels.

- b. In the event that a fishery closure is necessary, processors and fishermen will be given 24 hours advance notice of the emergency order closure.

7. Enforcement

- a. All on-site Department personnel will be expected to enforce all regulations.
- b. Coordinate daily activities with on-site Public Safety personnel.
- c. Request Public Safety personnel's assistance if it becomes necessary to cite processors under the registration/reporting regulations.

III. DATA RECORDING AND REPORTING

All data collected concerning commercial herring harvests and/or roe-on-kelp harvests will be summarized and reported by respective Department area management biologists and their staff.

IV. COMMUNICATIONS

- A. Communications gear will be available aboard each major support vessel. Field crews will be provided with portable communications equipment.
- B. Communication Gear Required:
 - 1. Both major support vessels will need: HF-SSB radio, with a complement of frequencies to match those available in the Dillingham Base HQ's transceiver (see below); 55-ch. VHF radio; and 40-ch. SSB C.B. radio. Both HF-SSB sets must be equipped with 4560 Khz, the new Bristol Bay monitoring frequency.
 - 2. All minor support vessels and roving field crews to be supplied with portable battery-operated 40-channel A.M. C.B. sets (standby Channel 7). Five of the portable

C.B.'s available.

3. Metervik Bay field site communications gear will consist of:
 - a. Battery operated (12-V) 40-channel mobile A.M. C.B. (standby Channel 7);
 - b. Battery operated (12-V) 55-channel VHF-F.M. marine radio-telephone (standby Channel 7A);
 - c. Battery operated (12-V) HF-SSB radio and tuner with the following frequencies: 2182, 2427, 2482, 3230, 3261, 4125, 4139, 4383, 4560, 5195, 6210 and 6213 (standby frequency 4560).
4. Dillingham base HQ's radios will be equipped with the following frequencies:
 - a. HF-SSB radio-transceiver/tuner with 2182, 2427, 2482, 2509, 2563, 3230, 3261, 4125, 4139, 4560 and 5195 (standby frequency 4560);
 - b. HF-SSB receiver only, with 1643, 2118, 2182, 2427, 2482, 2509, 2563, 2638, 3215, 3230, 3411, and 5195 (standby frequency 2482);
 - c. VHF-FM marine radio, 55-channel (standby channel 7A), with scanner capable of scanning 8 channels;
 - d. C.B. radio, SSB-AM, 40-channel (standby Channel 7).
- C. All stations in the Togiak District will use same standby channels and frequencies: HF-SSB, 4560 (and 2482 on Dillingham standby set); Marine VHF, Channel 7A; C.B. Channel 7.
- D. Channels 2182 and 4383 are Coast Guard distress frequencies.
- E. In addition to C.B. radio, one aerial surveillance aircraft (Nelson) will have portable marine VHF with Channels 6, 7A, 9 and 16 (standby Channel 7A).

F. Radio schedules with processors will be established by on-grounds surveillance crews (Vessels #1 and 2 and Metervik Bay camp) on a as needed basis. Radio schedules with Dillingham HQ's will take place on HF-SSB radio, 4560.

NOTE: Many details are still pending for several herring fishing districts concerning catch reporting, communications, registration, etc. These problems are being evaluated by various staff members at the present time. However, many of the logistical problems will be handled in season due to the uncertainty of commercial operations in those areas.

APPENDIX E. COMMERCIAL CATCH SAMPLING

OBJECTIVES

The objective of this portion of the 1979 Bering Sea operational plan is to outline the methods that will provide a statistically valid comparison of age class composition data by area, gear, and sampling period for the inshore Bering Sea herring harvest in 1979.

METHODS

Areas and Times of Interest

It is anticipated by the Department staff that significant commercial fisheries on Bering Sea herring will develop inshore at four different areas in 1979 and that additional areas may be fished. The greatest harvest is expected in the Togiak district of Bristol Bay (Fig. E-1) where the 1979 guideline harvest level is set at 12,000 metric tons. Anticipated timing of the Togiak fishery is from May 5 through June 5. The Togiak District is composed of four discrete fishing sections (Kulukuk section, Nunavachak section, Togiak section, and Hagemeister Strait section). Commercial harvests are expected from all sections with the majority of the harvest expected to take place in the Nunavachak and Kulukak sections. A significant fishery is anticipated to take place between May 20 and June 10 in the Security Cove District where the 1979 guideline harvest level is 350 metric tons (Fig. E-2). A small fishery may take place in the Goodnews Bay District between May 10 and June 10 where the guideline harvest level for 1979 is set at 100 metric tons. A commercial fishery is expected in Norton Sound at some time between May 15 and July 1. The Norton Sound guideline harvest level for 1979 is set at 500 metric tons divided into 350 tons for the northern section (Cape Denbigh area) and 150 tons for the southern section. Additionally, a fishery may develop in the Cape Romanzof District between

TOGIAK HERRING FISHING DISTRICT

SCALE: 1 inch = 14 miles

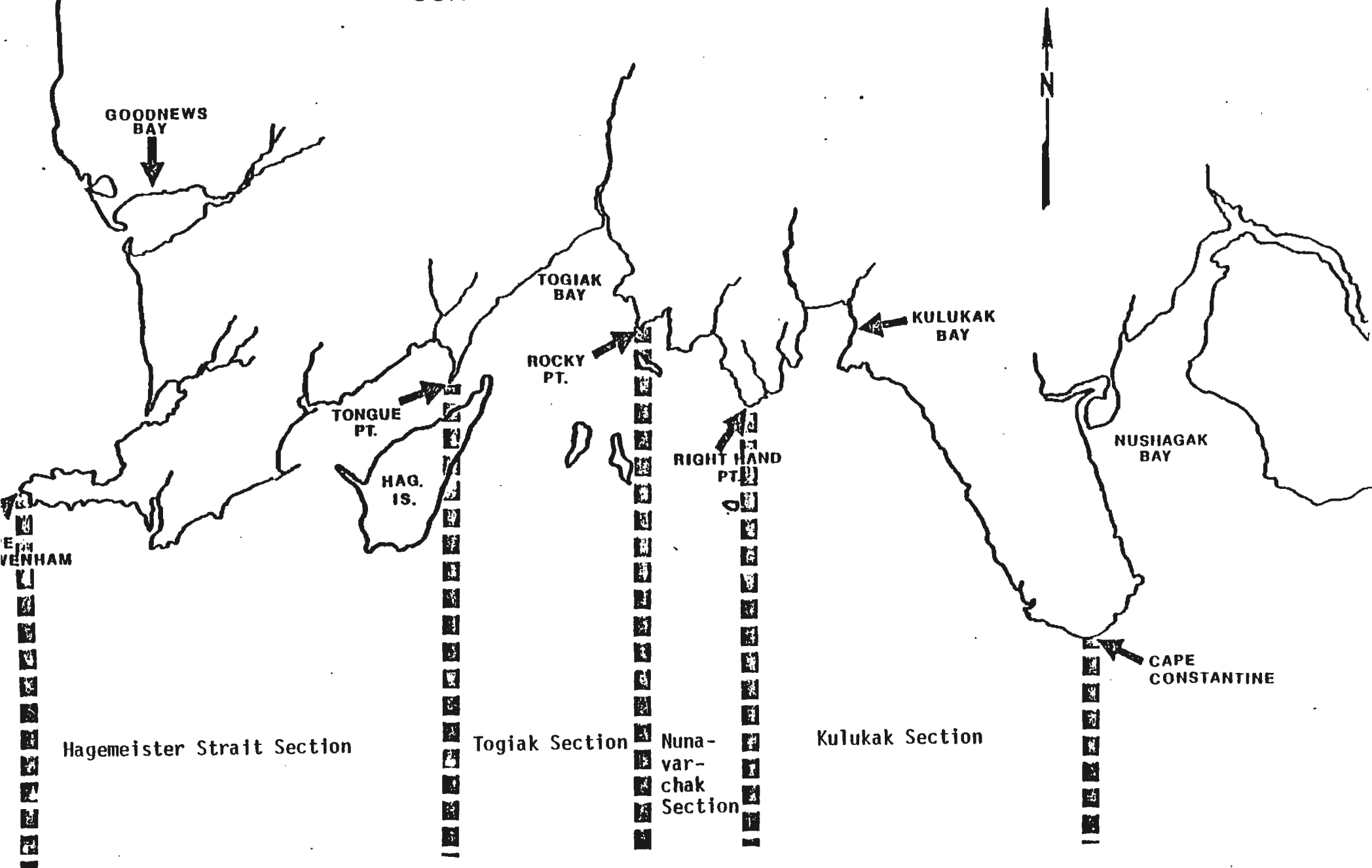


Figure E-1 Map of Togiak fishing district.

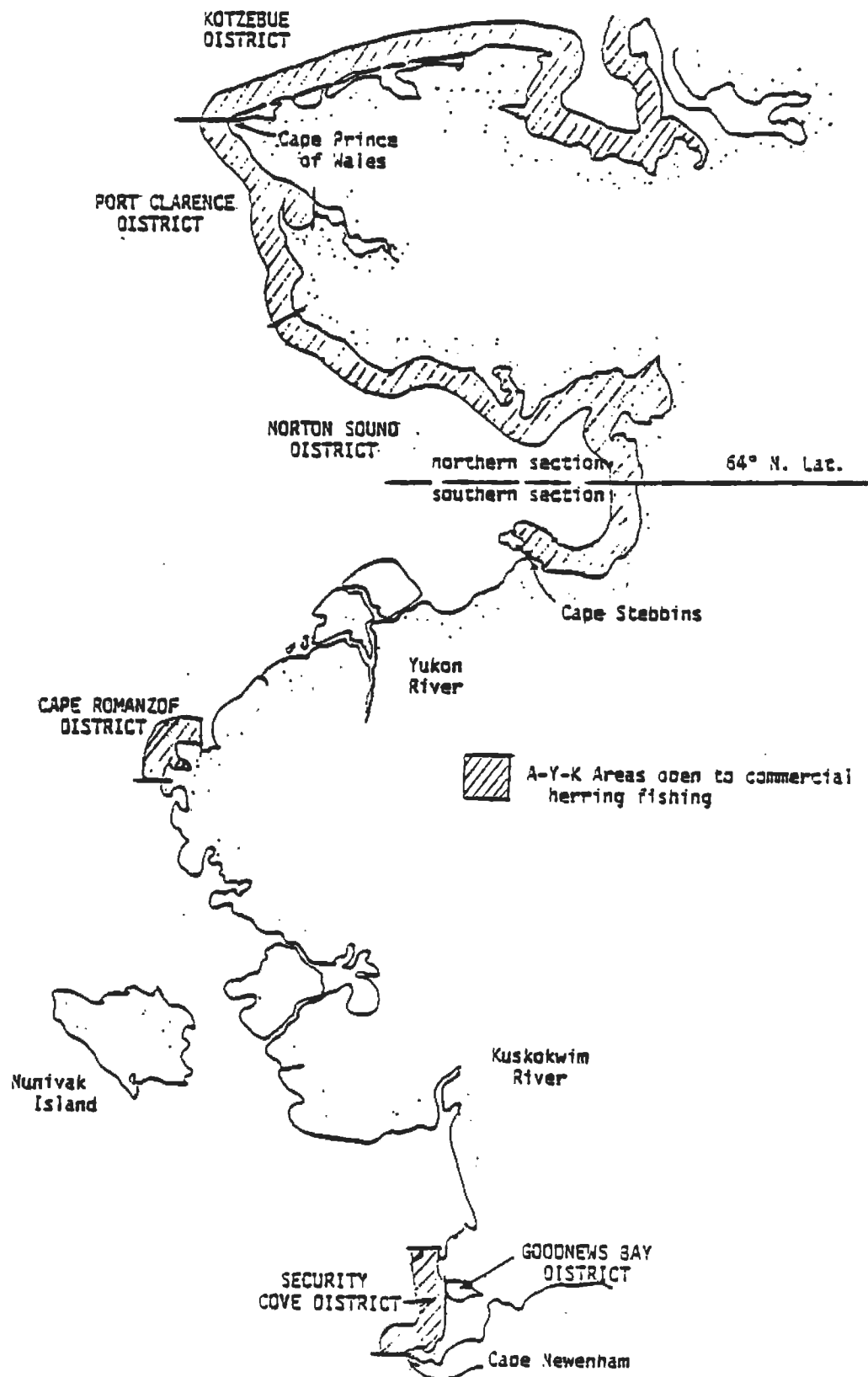


Figure E-2. Map of A-Y-K areas open to commercial fishing for herring.

May 20 and June 20 where the 1979 guideline harvest level is 350 metric tons.

In Bristol Bay, where a large inshore harvest is anticipated in 1979, commercial catch sampling periods will be defined on the basis of calendar weeks. The first sampling period will be from May 6 through May 12. If herring are harvested during this time period, a statistically valid sample of harvested herring will be obtained and sampled from each section fished for age, weight and length. The ensuing sampling periods will be from May 13 through May 19, May 20 through May 26, May 27 through June 2, and June 3 through June 9.

In fishing districts spread through the A-Y-K region, herring will be obtained and sampled for age, weight, length, and percent roe recovery data from each fishing section that is commercially harvested. An attempt will be made to sample each fishing section each calendar week that commercial fishing takes place, but logistics and staff support may be insufficient and hence sampling periods may have to be spread over two or more weeks.

Sample Procurement

Catch sampling most often will take place aboard tenders or processor ships. Samples will have to be drawn quickly at various stages in the tendering, unloading and holding process with the cooperation of industry personnel. The management biologist will be responsible for coordinating access to sampling points at the beginning of the season and advising catch samplers. Herring to be sampled will normally be held in bulk tanks, totes or holds aboard ship. A representative sample is desired and will be obtained by scooping with a bucket from at least four points in the load from top to bottom. Origin of the load as to section, gear type and date of catch must be determined. Percent roe recovery will be

determined by interview with processors whenever possible. Most frequently it will be necessary to transport the samples in plastic sacks back to the base camp or vessel for further processing.

Definition Description

Of A Single Sample

A single catch sample is defined as a collection of herring scales with appropriate length, weight, sex and gonad maturity statistics from a specific location during a given sampling period and captured with a single gear type. A description of areas and sampling periods has already been given. Two gear types are definitely expected, gill nets utilizing 2 1/4 inch to 2 1/2 inch mesh and 120 to 150 fathom purse seines. Beach seines may be used in some districts. For statistical purposes, the minimum sample size is 200. Rationale behind this sample size follows. It was found in 1978 that about 25 percent of the collected scales were not readable and hence, a field sample size of 200 will eventually equate to a "useable" sample size of about 150. A "useable" sample size of 150 will allow statistical estimation of age classes which represent 10 percent or more of total age class composition with an alpha level of 5 percent.

Data collected from each individual herring sampled will include standard length in millimeters (tip of snout to hypural plate), total weight in grams, sex, and sexual maturity (from visual examination of gonads). A single scale from each sampled herring will be mounted on a microscope slide and each slide will have ten such samples mounted on it. Data to be recorded on each microscope slide and on the corresponding A-W-L data form includes capture date, type of capture gear, and area and fishing section of the catch sample, as well as species and the fact that the data is taken from a sample of the commercial catch. Mounting

of scales on gum cards is an acceptable alternative to the use of glass slides provided that the same associated data are recorded.

More specific instructions on scale sampling techniques and completion of A-W-L sampling forms have been prepared and will be provided to the catch samplers.

PERSONNEL

Bristol Bay

Two temporary fishery technicians will be employed between May 5 and June 5 to collect commercial catch samples from Bristol Bay in 1979. Each of these technicians will work under the daily supervision of a permanent management biologist. The management biologist will direct the samplers to the portion of the commercial fleet to be sampled on a given day. Two state vessels will be present in the Togiak area and each will house one of the catch samplers and one permanent management biologist to facilitate the procurement of needed samples. It will be the responsibility of the permanent management biologist to insure quality of the data collection and to inform the Bristol Bay research staff as to the number of samples collected by location by sampling period. It will be the responsibility of the Bristol Bay research staff to inventory the data collections and insure that sufficient "in-season" catch sampling takes place. Some scales may be aged "in-season", however the majority will be read post-season by the herring research staff. The final analysis and report on catch sampling data will be the responsibility of the Bristol Bay research staff.

Security Cove

Most commercial catch samples collected from the Security Cove fishing district will be collected by the Kuskokwim area staff (Bethel) using the same format as just described. If for some reason the Kuskokwim

staff cannot adequately handle the task, the herring research team located at Goodnews Bay will obtain catch samples and collect the pertinent age, weight, length, and percent roe recovery data. Scale reading of Security Cove samples, data analysis, and report writing will be the responsibility of the herring research staff.

Goodnews Bay

Herring often spawn earlier here than in Security Cove. It is possible that some commercial deliveries will be made between May 10 to June 10. Fishing will be done by local residents using gill nets, consequently most of the catch is expected to be older, more uniform age herring. Catches will be sampled by the Goodnews Bay shore-based crew or Bethel based personnel may be required to travel to the Goodnews-Platinum area during the time that catches are being made and take samples from fishermen and processor boats.

In either case, radio communications and close coordination between the Goodnews Bay shore-based crew and the Bethel management staff will be required.

Norton Sound

The Northern section which includes Cape Denbigh has supported a small domestic commercial fishery in past years. Deliveries were all to the processing facility in Unalakleet in 1978. A catch sampler/management assistant stationed at Unalakleet collected samples in 1978 and could do so again in 1979, unless the fishery shifts out of the immediate area. Expected gear types in this fishery are primarily gill nets and possibly beach seines.

The Moses Point-Golovin area in the Northern section may also attract some fishing effort. Deliveries would be to the processing plant at Golovin. The management temporary assistant for Norton Sound will obtain catch samples since Golovin is included in the area from which he normally

collects commercial fish tickets and samples. He will be prepared to collect herring samples at any time during the period May 30 to July 31.

There is some possibility that part of the Bristol Bay herring fleet will travel to Norton Sound to catch herring. The Nome management staff will be alert to this possibility and will attempt to monitor fleet activities within the Norton Sound area. The catch sampler will be aware of fishing in the area and will be expected to maintain the sampling schedule set forth in this document for gear, area, and time period. If commercial fishing becomes more widespread and intense than expected, additional sampling assistance will be provided by the AYK research and management staff.

Cape Romanzof

A ground crew camped near the Air Force Base in 1978 found an early and a late peak in run timing at Cape Romanzof, during the period May 20 - June 20. The ground crew assigned here in 1979 will take the responsibility of obtaining sample collections in the event a fishery develops. Contacts at nearby villages and herring fleet monitoring will provide information about the fishery in time to arrange sampling visits. Lack of buyers in the area will inhibit the development of a local fishery, unless a floating buyer/processor moves into the area from Bristol Bay. Short time periods during which herring are nearshore in areas where they can be caught will limit the duration of commercial fishing to a very few days.

DATA REPORTING

A written report analyzing the 1979 catch samples taken from Bristol Bay will be prepared by the Bristol Bay research staff by September 15,

1979. A similar report for Security Cove and all other A-Y-K catch samples will be prepared by the herring research staff by September 15, 1979.

COMMUNICATION

All catch sampler in the Togiak district will be in contact daily by single side band radio with the Fish and Game office in Dillingham. The Dillingham office will be kept up to date on the status of the commercial catch samples so that the research staff can provide direction when needed.

The Bethel office will maintain radio communication with Dillingham and to monitor fleet movements and catch sampling needs in Security Cove and Goodnews Bay.

Communications in Norton Sound and Cape Romanzof will be by single side band radio to the Nome and Bethel offices, respectively.